Amendments to the Title:

Please replace the Title on page 1, line 2 with the following new Title:

METHOD OF MANUFACTURING A STATOR CORE

Amendments to the Specification and Abstract:

Page 1, directly below the heading "BACKGROUND OF THE INVENTION", please insert the following:

This application claims the benefit of Japanese Patent Application No. 2003-005840, filed on January 14, 2003; Japanese Patent Application No. 2003-106674, filed on April 10, 2003; and Japanese Patent Application No. 2003-309297, filed on September 1, 2003.

Please amend the paragraph beginning on line 16 of page 1 as follows:

Motor cores are made of non-oriented electrical steel sheets, which are manufactured through the application of cold rolling, including one or more ~~times~~ processes of annealing, to hot-rolled steel sheets that are adjusted to predetermined chemical compositions. Some of the manufacturing steps vary between semi-processed non-oriented electrical steel sheets and full-processed non-oriented electrical steel sheets. Semi-processed non-oriented electrical steel sheets are predicated on the application of stress-relief annealing after punching. The cold-rolled steel sheets are thus annealed at relatively low temperatures for a short time. The annealing also includes skin passed rolling in its final step. In contrast, full-processed non-oriented electrical steel sheets are not necessarily predicated on the stress-relief annealing of the core. The cold-rolled steel sheets are thus annealed at higher temperatures for a longer time than the semi-processed non-oriented electrical steel sheets are. To ease this annealing condition, the hot-rolled steel sheets are sometimes annealed.

Please amend the paragraph beginning on line 13 of page 3 as follows:

As a result of these measures for reducing ~~in~~ iron loss by means of reduced thicknesses and increased resistivities, non-oriented electrical steel sheets have been considerably reduced in iron loss as compared to heretofore. Nevertheless, the reduction in iron loss resulting from the reduced thickness and increased resistivity of the electrical steel sheets is ascribable to a reduction of the eddy current loss out of the iron loss expressed by the foregoing equation. The hysteresis loss is not reduced by a reduction in thickness or an increase in resistivity. As the eddy current loss decreases, the ratio of the hysteresis loss to the entire iron loss increases relatively from conventional 70% or so

to 90% or so. For future measures for a reduction in iron loss, it is thus becoming increasingly important to reduce the hysteresis loss.

Please amend the paragraph spanning line 23 of page 3 to line 6 of page 4 as follows:

The hysteresis loss of an electrical steel sheet has a close relationship with magnetic induction, and magnetizing feature can be improved to reduce the hysteresis loss. Consequently, ~~it is how to improve~~ improvement in the magnetizing ~~feature, that~~ feature matters for the sake of a reduction in hysteresis loss. The magnetizing feature can be improved by making the crystal direction of an electrical steel sheet to be a random cubed direction. For concrete means, one of the inventors has developed a non-oriented electrical steel sheet which is switched from a conventional Si-rich composition to an Al-Mn rich composition to achieve both reduced iron loss and improved magnetizing feature (see Unexamined Japanese Patent Publication No. 2002-146490).

Please amend the paragraph beginning on line 10 of page 8 as follows:

Ordinary motors are typically used in commercial power frequencies at magnetic induction of the order of 1.4 to 1.8 T. The stator cores of the motors to be driven under such high fields do not have ~~not~~ much ~~margins~~ margin for improving their magnetizing feature through the annealing of the stator cores, nor for improving magnetic induction through magnetic annealing. That is, the magnetic annealing promises little effect. With the stator cores of motors to be driven under lower magnetic fields of 1.0 T or less in magnetic induction, in contrast, the magnetic annealing provides a significant effect if the cores are annealed under an appropriate condition of field application. In this respect, description will be given with reference to Fig. 1.

Please amend the paragraph spanning line 18 of page 8 to line 6 of page 9 as follows:

Fig. 1 shows a graph called a B-H curve which shows the relationship between magnetizing force H and magnetic induction B. The magnetizing force H on the abscissa indicates the intensity of an electric current, which is the force for magnetization, in terms of a total current per meter in units of A/m. The magnetic induction B on the ordinate indicates, in units of T (tesla), up to how many magnetic lines of force can be absorbed for a given magnetizing force H. In the graph, the

curve (1) shows measurements on a sample that is made of electrical steel sheets, or the material, as punched. The curve (2) shows measurements on the sample of (1) that has been annealed without any magnetic field. The curve (3) shows measurements on the sample of (1) that has been magnetic-annealed. The material was commercially available Si-rich non-oriented electrical steel sheets (equivalent of JIS C2552 35S230), having a thickness of 0.35 mm. The steel sheets were punched into a ring shape having an outer diameter of 80 mm and an inner diameter of 60 mm. The heating temperature at the time of annealing was 750°C. The magnetic field was applied in the process of cooling from 750°C to 300°C.

Please amend the paragraph beginning on line 7 of page 9 as follows:

As can be seen from Fig. 1, a difference between nonmagnetic annealing and magnetic annealing (the distance between the curves (2) and (3)), i.e., the effect of the magnetic ~~annealing~~ annealing, is small in the area where the magnetic induction B is 1.4 to 1.8 T, which is the driving condition for ordinary motors. Now, in the area of lower magnetic fields where the magnetic induction B is 1.0 T or lower, which is the driving condition for electric vehicle motors, the magnetic annealing provides an extremely high effect. The B-H curve rises at a sharp angle in the case of the magnetic annealing in particular. The point of the maximum permeability (indicated with a solid circle on the graph) shifts toward lower magnetizing forces, with a significant improvement to the magnetizing feature in lower magnetic fields.

Please amend the paragraph spanning line 17 of page 9 to line 3 of page 10 as follows:

The stator core itself is composed of crystals each containing a plurality of magnetic domains. The domains ~~once~~ disappear at temperatures above the Curie point (for example, approximately 720°C in the case of Si-rich non-oriented electrical steel sheets) when the stator core is annealed, and reappear when cooled to temperatures below the Curie point. When a magnetic field is applied in the cooling process, most of the plurality of domains that reappeared are oriented with their directions of magnetization along the direction of the magnetic field applied. Subsequently, the application of the magnetic field is ~~quit~~ stopped at 300°C, so that the directions of magnetization of

the respective domains are fixed, in principle, to the direction of a magnetic easy axis (any one of crystal axes [100], [010], and [001]) that is three-dimensionally closest to the direction of the magnetic field applied so far. As a result, higher magnetic induction is obtainable at lower magnetic fields. That is, the point of the maximum permeability shifts toward lower magnetizing forces.

Please amend the paragraph beginning on line 1 of page 11 as follows:

For further enhancement ~~to~~ of the effect of the magnetic annealing, the stator core desirably has a grain size of 100 μm or greater at the time of field application. The greater grain size the stator core has upon field application, the smaller the total area of the grain boundary becomes. The domains after the magnetic annealing thus become easier to orient in the same direction of magnetization with ~~an~~ a corresponding improvement ~~to~~ in the magnetizing feature ~~accordingly~~. Then, the stator core desirably has a grain size as great as possible, at least at the point in time when the magnetic field is applied at the temperature immediately above the Curie point. In particular, grain sizes of 100 μm or greater enhance the effect of the field application. It is therefore desirable that the stator core itself at the time of field application be given a greater grain size by either of the following means: fabricating the stator core by using non-oriented electrical steel sheets having a grain size of 100 μm or greater (such as equivalents of JIS C2552 35S230); and fabricating the stator core by using non-oriented electrical steel sheets having a grain size below 100 μm (such as equivalents of JIS C2552 35S300) and heating the stator core to around 850-900°C in an H_2 or (H_2 + Ar) atmosphere for grain growth. In the case of the stator core that is made of non-oriented electrical steel sheets of 100 μm or greater in grain size, the heating up to the temperature immediately above the Curie point may be immediately followed by the field application and cooling. On the other hand, in the case of the stator core that is made of non-oriented electrical steel sheets of below 100 μm in grain size, the crystal grains are preferably grown in the foregoing manner before the magnetic field is applied thereto in the cooling process. For example, when the stator core is made of non-oriented electrical steel sheets that have been given skin passed rolling in the final step of fabrication, the crystal grains of the stator core can grow to a grain size of 200 μm or so when the stator core is heated for annealing.

Please amend the paragraph beginning on line 13 of page 12 as follows:

Fig. 2A shows a seat 1, an axial rod 2, and a pipe member 3 for stacking stator cores (hereinafter, referred to as cores) C to be annealed. The pipe member 3 is a heat-resistant silica tube. Fig. 2B shows five cores (C1 to C5). In the present embodiment, each of the cores C is a lamination of non-oriented electrical steel ~~sheets~~ <u>sheet layers</u> as material which have been punched in a ring shape. Each core has an outer diameter of 300 mm, an inner diameter of 200 mm, and a thickness of 200 mm. The height of the five cores stacked is 1000 mm.

Please amend the paragraph beginning on line 21 of page 14 as follows:

A thermometer 11 is used to confirm, from its temperature detection value, that the internal temperature of the cores C reaches 750-850°C. Then, the heating by the winding coil 8 is stopped to cool the cores C. After the start of cooling, at the point that the internal temperature of the cores C falls to approximately 750°C, the linear coils 10 are energized with DC currents of 12000 A/m from a DC power supply (not shown) so that the magnetic field is applied to the cores C. The cooling accompanied with the field application is continued until the internal temperature of the cores C falls to approximately 300°C. Below 300°C, the field application is ~~quit~~ <u>stopped</u> for natural cooling.

Please amend the paragraph spanning line 21 of page 14 to line 4 of page 15 as follows:

In this cooling process, a plurality of domains in the crystals of the cores C reappear which have ~~once~~ disappeared ~~by the~~ <u>due to</u> heating ~~at~~ <u>to</u> the Curie point and over. Because of the field application in the cooling process, most of the plurality of domains reappearing are oriented with their directions of magnetization along the direction of the magnetic field applied. Subsequently, when the application of the magnetic field is ~~quit~~ <u>stopped</u> at 300°C, the directions of magnetization of the respective domains are fixed to the direction of a magnetic easy axis (any one of crystal axes [100], [010], and [001]) that is three-dimensionally closest to the magnetic field applied so far. Consequently, high magnetic induction is obtainable in lower magnetic fields.

Please amend the paragraph spanning line 15 of page 18 to line 14 of page 19 as follows:

Fig. 4 shows B-H curves representing the magnetizing feature graphically. In the chart, the curves (2) and (3) are the same as those in Fig. 1. The curves (4), (5), (6), and (7) show the results of the nonmagnetic annealing of the sample 50HS01, the magnetic annealing of the sample 50HS01, the nonmagnetic annealing of the sample 50HS11, and the magnetic annealing of the sample 50HS11, respectively. As can be seen from Table 3 and Fig. 4, even the sample 35H230 made of steel sheets without skin passed rolling, if given the magnetic annealing, achieved approximately 1.6 times of improvement in the magnetic induction B0.5 in lower magnetic fields and approximately 14% of reduction in the iron loss W7/50 with respect to the case of the nonmagnetic annealing. The sample 50HS01 made of skin-passed rolled steel sheets was lower than the sample 35H230 in Si content and thus inferior to the sample 35H230 in terms of magnetizing feature, whereas it had a large grain size and thus displayed a high effect of cooling in a magnetic field. The magnetic induction B0.5 of the sample 50HS01 in lower magnetic fields was higher than that of the sample 35H230. The sample 50HS11 made of Al-rich steel sheets, even with the nonmagnetic annealing, showed a greater magnetic induction B0.5 in low magnetic fields than the samples 35H230 and 50HS01 made of Si-rich steel sheets with the magnetic annealing did, and the magnetic induction B0.5 with the magnetic annealing was even greater. The foregoing confirms that the application of magnetic annealing to a core can improve the magnetizing feature, that the use of the electrical steel sheets given skin passed rolling in the final step provides a further improvement to the magnetizing feature ~~with respect~~ as compared to the case where electrical steel sheets without skin passed rolling are used, and that the use of Al-rich electrical steel sheets achieves ~~a~~ still a further improvement to the magnetizing feature.

Please amend the paragraph spanning line 17 of page 21 to line 3 of page 22 as follows:

As shown in Table 4 and Fig. 5, the non-annealed sample and the nonmagnetic-annealed sample sharply drop in saturation induction when the frequency of the exciting current exceeds 200 Hz. The output factors, expressed in terms of the product of the frequency and the saturation induction, show little increase at frequencies of 200 Hz and above. In contrast, the saturation induction of the magnetic-annealed sample gently falls as the frequency of the exciting current

increases. In particular, in the range from 400 to 600 Hz, which is the frequency range of the high frequency exiting current to be employed in electric vehicle motors, the sample provides output factors at least twice ~~or more~~ those of the non-annealed or nonmagnetic-annealed sample. This confirms that when the motor stator core according to the present invention is used for an electric vehicle motor, it is possible to provide motor power at least twice ~~or more~~ that of the electric vehicle motor using a conventional motor stator core, or to miniaturize the motor for the same power.